DIRECT TESTIMONY OF

ERIC H. BELL

ON BEHALF OF

SOUTH CAROLINA ELECTRIC & GAS COMPANY

DOCKET NO. 2019-2-E

Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND OCCUPATION.

A. My name is Eric H. Bell. My business address is 220 Operation Way, Cayce, South Carolina. I am Manager of Economic Resources Commitment for South Carolina Electric & Gas Company ("SCE&G" or the "Company").

Q. STATE BRIEFLY YOUR EDUCATION, BACKGROUND, AND EXPERIENCE.

A. I am a graduate of the University of Texas with a Bachelor of Science degree in Electrical Engineering and am licensed in South Carolina as a Professional Engineer. Following graduation, I served in the United States Navy as a Nuclear Submarine Officer. In 1994, I began my career with SCE&G as Assistant Plant Engineer and in 1997 was promoted to Operations Planner for the Company. From 2001 to 2008, I was responsible for the Company's economic resource commitment efforts and, in 2008, I assumed my current role as Manager of Economic Resources Commitment. In this position, I am responsible for managing and optimizing

generation fleet operations to provide reliable reasonably-priced energy to SCE&G customers. Among other things, my responsibilities include participating in fuel purchasing decisions, unit commitment, and the coordination of activities with power marketing, transmission system control, maintenance scheduling, and natural gas supply.

Q. HAVE YOU PREVIOUSLY TESTIFIED AS AN EXPERT WITNESS BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA ("COMMISSION")?

A. No, this is my first time appearing before the Commission.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to discuss the actual operational experience of the Company related to managing energy supply including the photovoltaic ("PV") solar generation facilities interconnected with SCE&G's system. I also discuss the reference data and other inputs derived from this operational experience, which the Company provided to Navigant Consulting, Inc. ("Navigant") in connection with the PV solar generation facility impact study sponsored by Company Witness Dr. Matthew W. Tanner. Finally, I discuss the Company's review of the Navigant simulations.

Q. HAS THE COMPANY EXPERIENCED A RECENT INCREASE IN THE AMOUNT OF SOLAR FACILITIES INTERCONNECTED WITH ITS SYSTEM?

A. Yes. The Company has recently experienced a significant increase in PV generator interconnection interest in the previous two year period. A 2 MW rooftop installation and approximately 7 MW of Distributed Energy Resource ("DER") utility-scale installation were the only utility-scale PV solar generators in the SCE&G service territory before 2017. By December 31, 2018, approximately 433 MW of PV solar generation was interconnected to the SCE&G system. Those facilities include approximately 63 MW in residential behind-the-meter systems, 6 MW in commercial behind-the-meter systems, 19 MW in commercial in-front-of-the-meter systems, and 345 MW in "utility-scale" solar (14 MW is community solar and 331 MW is other utility-scale to include DER utility-scale facilities).

Q. ARE THERE ADDITIONAL SOLAR FACILITIES THAT SCE&G EXPECTS TO BE INTERCONNECTED TO ITS SYSTEM IN THE NEAR FUTURE?

A. Yes. In addition to the facilities already interconnected and providing power to the SCE&G system, another 14 non-DER solar facilities and 1 DER solar facility have executed agreements with the Company to provide additional solar power to SCE&G's system. Each of these facilities is expected to enter commercial operation between now and the end of 2020; when constructed and interconnected, these

additional facilities will add approximately 705 MW of additional solar generation to the Company's system. Following these interconnections, which are projected to be made by the end of 2020, and along with the projected growth of 16 MW in residential and commercial behind-the-meter systems SCE&G expects to have a total of 1,154 MW of solar facilities interconnected with its system by the end of 2020.

Q. DOES THIS AMOUNT OF SOLAR GENERATION CREATE ANY CHALLENGES IN SAFELY AND RELIABLY OPERATING SCE&G'S SYSTEM IN COMPLIANCE WITH REGULATORY REQUIREMENTS?

A. Yes. Solar generation is a variable energy resource, meaning that it cannot be dispatched or predicted exactly. Normally, dispatchable generation is added in economic merit order as system load increases and removed as load decreases. By comparison, solar generation is a product of uncontrollable factors such as available sunlight and cloud cover, and a solar facility's output is not necessarily responsive to system needs. Because of this variability in generation, SCE&G must make operational adjustments to follow the energy generated by solar facilities and to maintain sufficient reserve generation capability in order to meet system reliability requirements. In addition to being variable moment to moment, solar generation varies from the solar generation forecast which also creates a need for reserves. It is anticipated that solar generation will eventually exceed SCE&G's ability to provide adequate reserves unless SCE&G maintains more hourly operating reserves

or adds more quick start resources to its system. SCE&G has an obligation to balance generation to load and maintain reserves at all times as discussed further below.

Q. GIVEN THIS VARIABILITY, HOW DOES SCE&G PLAN FOR THE AMOUNT OF SOLAR GENERATION THAT IS PUT TO ITS SYSTEM ON A DAILY BASIS?

A. On a regular basis, both the generation owners and the Company forecast the expected amount of solar generation, taking into account anticipated weather conditions and the characteristics of the individual generating facilities. Because actual weather conditions can vary greatly from forecasts, projections of anticipated solar generation are much less reliable than those of other generating resources such as a natural gas or coal-fired generation facility. Some, but not all, of the forecasted solar generation can be expected with reasonable certainty; however, when the amount of solar energy actually generated does not meet the forecasted projections, the shortfall must be supplied by generation from another resource. The utility must be ready for the unexpected loss of solar generation well ahead of the contingency. Traditional types of generators cannot begin generating electricity immediately, but must be given adequate time to be brought on line and respond when called upon to fulfill unexpected shortfall. Although some types of smaller generators on SCE&G's system can start quickly from an offline standby condition, the amount

of capacity they can supply is limited. SCE&G's larger generators need to be brought on line well ahead of the contingency.

Q. HOW DOES SCE&G PLAN FOR SUCH OCCURRENCES?

A. The Company is subject to requirements established by the North American Electric Reliability Corporation (NERC) and the SERC Reliability Corporation. The Company also is a signatory to the VACAR (Virginia/Carolinas) Reserve Sharing Arrangement through which it maintains required reserve generation capability at all times in the event of a contingency—i.e., a reserve call from a neighboring utility, a sudden loss of generation such as when a generating facility is unable to generate electricity, or unexpected and higher demand on the Company's system. When a VACAR reserve sharing partner calls upon reserves or an SCE&G generator experiences a sudden unplanned forced outage, reserve capability is being "used," and does not need to be reestablished immediately under the terms of the VACAR Reserve Sharing Arrangement. However, when the territorial load exceeds forecast or non-dispatchable solar generation is not producing the expected level of electric generation, SCE&G must ensure that other generation is producing power to meet load and make other generation supply available to maintain the reserve requirement. Under these circumstances, SCE&G must have generators available or online that are capable of quickly and reliably producing electricity so the sudden shortfall can be met.

Q. HOW ARE CONTINGENCY RESERVES SUPPLIED?

A. Contingency reserves must be supplied on demand within fifteen minutes and include spinning and non-spinning reserve requirements. Spinning reserves are provided by generators that already are online but not operating at full capacity and therefore can immediately generate additional electricity to serve the load. Non-spinning reserves may be supplied by both online and offline generators that can be fully loaded within fifteen minutes. The generators with the fastest response capability are quick-start internal combustion turbines ("ICTs"), some hydropower facilities, and pumped storage generators ("Pumped Storage"). Economical operation of ICTs normally has them offline in stand-by and supplying non-spinning reserve capability much like Saluda Hydro provides spinning and non-spinning reserves. In the future, both of those types of units will continue operating in the same way from the standby mode.

Q. HOW IS SCE&G ABLE TO INCREASE ITS AMOUNT OF AVAILABLE RESERVE CAPACITY?

A. The only way to increase reserves from ICTs and Saluda Hydro is to construct additional units. Reserves from quick starts and Saluda Hydro have been fully utilized for years, and no additional reserve value can be gained from those existing units. While Pumped Storage does supply spinning and non-spinning reserves, the optimal operation of Pumped Storage is dictated by economical limitations. Creating additional reserves by holding back Pumped Storage adds fuel

costs in most circumstances because the output from higher cost generating units must be increased. In addition, the Company can increase its reserves by operating more coal and gas-fired baseload units. However, doing so may require SCE&G to operate its natural gas or coal-fired generating facilities under low load conditions or at an output level that is less efficient, i.e., more costly, than the optimum level for which they were designed. Thus, there is a cost to operating the generating units that provide these higher reserve levels, and those costs increase as more reserves are required.

Q. HAS THE COMPANY ATTEMPTED TO QUANTIFY THESE OPERATIONAL COSTS?

A. Yes. As further discussed by Company Witness Dr. Matthew Tanner, SCE&G engaged Navigant to evaluate the operational and financial impact of serving SCE&G's customers with PV solar generation in addition to the Company-owned resources.

Q. IN PREPARATION FOR THIS STUDY, DID SCE&G PROVIDE NAVIGANT WITH OPERATIONAL DATA FROM THE COMPANY?

A. Yes. The Company provided Navigant with information concerning SCE&G's NERC/VACAR operating requirements, as well as input and reference data related to the PV solar generation facilities interconnected with SCE&G's

system. The Company also provided Navigant with forecasts shown in Table 1 below.

Table 1

	Summer Peak (MW)	Winter Peak (MW)	Energy Sales (GWh)
2019	4,639	4,749	22,654
2020	4,688	4,792	22,828
2021	4,733	4,822	23,014
2022	4,772	4,860	23,153
2023	4,810	4,882	23,331
2024	4,835	4,921	23,461
2025	4,874	4,963	23,649
2026	4,919	5,007	23,879
2027	4,961	5,046	24,123
2028	5,003	5,085	24,353
2029	5,042	5,124	24,581
2030	5,084	5,166	24,807
2031	5,125	5,208	25,061
2032	5,168	5,248	25,310
2033	5,208	5,290	25,563

In addition, the Company provided Navigant with its current resource plan showing the need for additional capacity during the next fifteen years and identifying, on a preliminary basis, whether the need is for summer or winter capacity. The current resource plan is attached to the Direct Testimony of Company Witness Mr. James Neely in Table 1 of Exhibit No. ___ (JWN-1). SCE&G also provided Navigant with the Company's peak seasonal demand, energy sales, and self-owned generation portfolio, as well as information concerning generator characteristics, including size in megawatts, fuel cost, efficiency, and operating flexibility. This information is included in the Company's 2019 IRP filed on

February 8, 2019, in Docket No. 2019-9-E, which I incorporate herein by reference, and provides an accurate representation of the Company's dispatchable electric supply. Finally, the Company provided information concerning actual solar generation profiles from existing projects, existing solar PPAs, forward fuel prices, and natural gas pipeline contracts.

Q. DID THIS INFORMATION INCLUDE PROFILES OF SOLAR FACILITIES INTERCONNECTED WITH SCE&G'S SYSTEM?

A. Yes. The Company provided Navigant with hourly solar energy profiles from actual solar installations with energy production from five geographic areas in the SCE&G service territory. On the SCE&G system, the PV Solar generation energy production profile is dominated by the utility-scale single-axis tracker with panel capability in excess of the plant rating and inverter capability. On sunny days, this generating profile sharply increases from sunrise to nearly full load electrical output in less than 2 hours. PV Solar output then stays at or near full load until about 2 hours before sunset, unless there is cloud cover. On partly cloudy days, the profile is extremely volatile and much less predictable. Cloudy days result in expectedly low generation output. Although this relationship is conceptually simple, the partly cloudy and cloudy days are the most difficult to forecast and can cause large deviations from the generating forecast. In all cases, the Company must anticipate and plan for significant variations from the forecast and, therefore, maintain adequate reserves to balance the load.

Q. PLEASE BRIEFLY DESCRIBE NAVIGANT'S CASE STUDIES.

A. In the Navigant study, each variation, or "case," simulates the introduction of more installed solar generation that supplies energy to SCE&G's system. In connection with the study, SCE&G provided Navigant with estimates of the amount of solar generation expected to be interconnected with its system by 2020. The original scope of the study was to include varying estimates of solar generation to displace fossil-fueled and hydro generation of 350 MW, 725 MW, and 1,050 MW. These amounts reflected, respectively, 1) 350 MW of solar generation under construction and expected to be interconnected with SCE&G's system by the end of 2018; 2) an additional 375 MW (725 MW total) of solar generation expected to be interconnected by the end of 2019; and 3) an additional 325 MW (1,050 MW total) of additional solar generation projects expected to be interconnected by the end of 2020. At the time the study was originally commissioned, these tranches were reasonable approximations of the amount of solar capacity expected to interconnect with SCE&G's system in each year.

After the study commenced, SCE&G provided Navigant with updated information regarding the actual amount of solar generation on its system and expected to interconnect with its system pursuant to signed PPAs. As a result, the Navigant study analyzed the impact of the actual amount of solar interconnected and expected to be interconnected with its system by the end of 2020, reflecting 1) 336 MW of solar generation actually under construction and expected to be interconnected with SCE&G's system by the end of 2018; 2) an additional 301 MW

(637 MW total) of solar generation expected to be interconnected by the end of 2019; and 3) an additional 407 MW (1,044 MW total) of additional solar generation projects expected to be interconnected by the end of 2020. These updated estimates remained throughout the study as the basis for each study case with the Baseline at 336 MW, Case 1 at 637 MW and Case 2 at 1,044 MW.

Q. HOW DO THE ESTIMATES OF SOLAR GENERATION USED IN THE STUDY COMPARE TO THE ACTUAL EXPERIENCE OF THE COMPANY AND ITS UPDATED FORECASTS?

A. The estimates used in the study are very similar to, but less than, the actual amounts of utility-scale solar generation interconnected to SCE&G's system by the end of 2018 and currently forecasted by the Company to be interconnected by the end of 2019 and 2020. Specifically, the cumulative nameplate facility rating of utility-scale solar generation actually interconnected with the Company's system by the end of 2018 was approximately 345 MW, as compared to the Navigant Baseline scenario of 336 MW. Based upon the solar generators currently interconnected with SCE&G's system or under construction, SCE&G forecasts that approximately 643 MW (cumulative nameplate facility rating) of utility-scale solar generation will be interconnected with its system by the end of 2019, as compared to the Solar Case 1 scenario of 637 MW. Finally, based upon the PPAs executed by potential solar owners/operators, SCE&G forecasts that approximately 1,050 MW (cumulative nameplate facility rating) of utility-scale solar generation will be interconnected

with its system by the end of 2020, as compared to the Solar Case 2 scenario of 1,044 MW.

When residential behind-the-meter systems, commercial behind-the-meter systems, and commercial in-front-of-the-meter systems are considered, the estimates used in the study are lower than annual totals that are expected to reach 1,154 MW of generation capability by 2020.

Q. DID SCE&G REVIEW THE RESULTS OF THE NAVIGANT'S SIMULATION?

A. Yes. Navigant uses a modeling software known as PROMOD®, which is a production cost model that simulates the dispatch of generating units based upon theoretical operating scenarios. These models are used to analyze electricity system costs including how system costs change when aspects of those systems change. In order to verify that Navigant's simulations reflected SCE&G's actual operating experience, the Company's Economic Resource Commitment and Resource Planning departments reviewed the baseline scenario and recommended adjustments with respect to certain operating parameters and characteristics. As a result, the PROMOD® simulations reasonably reflect the actual operating characteristics of SCE&G's system.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes.